



# Green Sentiment, Stock Return and Corporate Behavior

**M. Brière** (Amundi, Paris Dauphine University), **S. Ramelli** (University of Zurich)

*3<sup>rd</sup> European Commission Summer School on Sustainable Finance, July 2021*

---

## Background

### **Environmental concerns play an increasing role in financial markets**

#### **(1) More information on the cost of climate change**

- For ex, global costs of weather disasters (hurricanes Katrina and Sandy, tropical cyclones, wildfires) rose significantly, related to global warming

#### **(2) Regulatory initiatives**

- Especially in Europe (European commission action plan for sustainable finance, green taxonomy, European labels, etc.)

#### **(3) Banks and institutional investors' commitments to climate initiatives**

- For ex: Climate Finance Leadership Initiative / Climate Action 100+, Principles for Responsible Banking

#### **(4) More appetite from individual investors for green products**

- Evidence on pension plans: Bauer et al. (2019), Brière and Ramelli (2021)

---

## Background

**Higher environmental concerns have two different impacts on green stock returns:**

1. **Higher awareness of climate risks**, changing the way investors incorporate fundamental information (Engle et al., 2020) → **fundamental demand**
2. **Higher “willingness to pay” for environmental responsibility** (Pastor, Stambaugh, and Taylor, 2020) → **non-fundamental demand**

**Empirical challenge:** How to disentangle these two components and study their effects on financial markets?

**Policy relevance:** Investors/regulators need to understand what the current pricing of green firms is reflecting

→ Recent outperformance of green stocks may reflect both components

→ Willingness to pay can fluctuate, important to manage the risks of a “green bubble”

---

# Research questions and preview of main results

## 1. How to proxy for shifts in investors' non-fundamental green demand ?

- We propose a new method to measure non-fundamental demand (“**green sentiment**”) based on **abnormal inflows into green ETFs**.

## 2. What is the impact of green sentiment on asset prices?

- Higher green sentiment is associated with an **out-performance** of greener stocks (60 bp over 6 months for 1 stdev higher green sentiment).

## 3. What is the impact of green sentiment on firms' decisions?

- Higher green sentiment is associated with **higher capex and cash accumulation** by green firms, especially those that are more equity dependent.

---

## Related Literature

- **Investors' sentiment**
  - Identification and impact on stock returns (Baker and Wurgler, 2006 ; Baker et al., 2012 ; Ben-David et al., 2020)
  - Measuring **non-fundamental demand from ETFs' arbitrage activity** (Brown, Davis and Ringgenberg, 2020 ; Davies, 2020)
- **Pricing impact of climate news**
  - Engle et al., 2020 ; Ossola et al., 2020
- **Implications of changing investors' beliefs about climate**
  - Measuring the beliefs of marginal investors or CEOs (Choi et al., 2019 ; Alok et al., 2019 ; Krueger et al., 2020)
  - Characterizing **new market equilibrium with heterogenous investors** with different ESG tastes (Pastor et al., 2020 ; Zerbib, 2020)

---

# 01

## Identifying green sentiment from ETF arbitrage activity



---

# Identifying Green Sentiment

## ETFs offer a unique setting to identify non-fundamental demand shocks

- ETFs and their underlying assets (UA) have the **same fundamental value**
- ETFs are more prone to sentiment than UA, due to their **different ownership**
- Violations of the law of one price between ETFs and UA reveal **non-fundamental demand**
- Mispricings incentivize arbitrageurs to **create or redeem ETF shares**, creating **observable ETF flows**

Literature on ETFs and non-fundamental demand: Ben-David, Franzoni, and Moussawi (JF, 2017), Brown, Davies, and Ringgenberg (RF, 2020), Davies (JQFA, 2020).

We use the **abnormal flows into green ETFs** as a proxy of market-wide **changes in investor appetite for environmental responsibility** that are **not priced** in the value of the underlying assets → **proxy for non-fundamental demand**

---

# Identifying Green Sentiment

## Measuring green ETFs abnormal flows

- To measure the creation/redemption activity by arbitrageurs (APs), we define  $Flows_{i,t}$  as the % change in monthly ETF Nb of shares outstanding

$$Flows_{i,t} = \frac{Shares\ outstanding_{it}}{Shares\ outstanding_{it-1}} - 1$$

- To get the time series dynamics of green sentiment, we perform  $T$  cross-sectional regressions of monthly ETF flows on a green dummy + controls

$$Flows_{i,t} = c_t + \gamma_t * green_{i,t} + \delta_t * controls_{i,t} + \varepsilon_{i,t} \quad \forall t$$

$$\gamma_t = Green\ sentiment_t$$

**NB:** This allows us to control for the massive inflows / increases in popularity for all ETFs. We capture the demand for green ETFs that is distinct from aggregate ETF demand.



# Identifying Green Sentiment

## Data and green ETFs

All US-listed equity ETFs, drop L-S and funds investing exclusively outside US → **1,195 ETFs**  
Data from Bloomberg, Morningstar and ETF Global

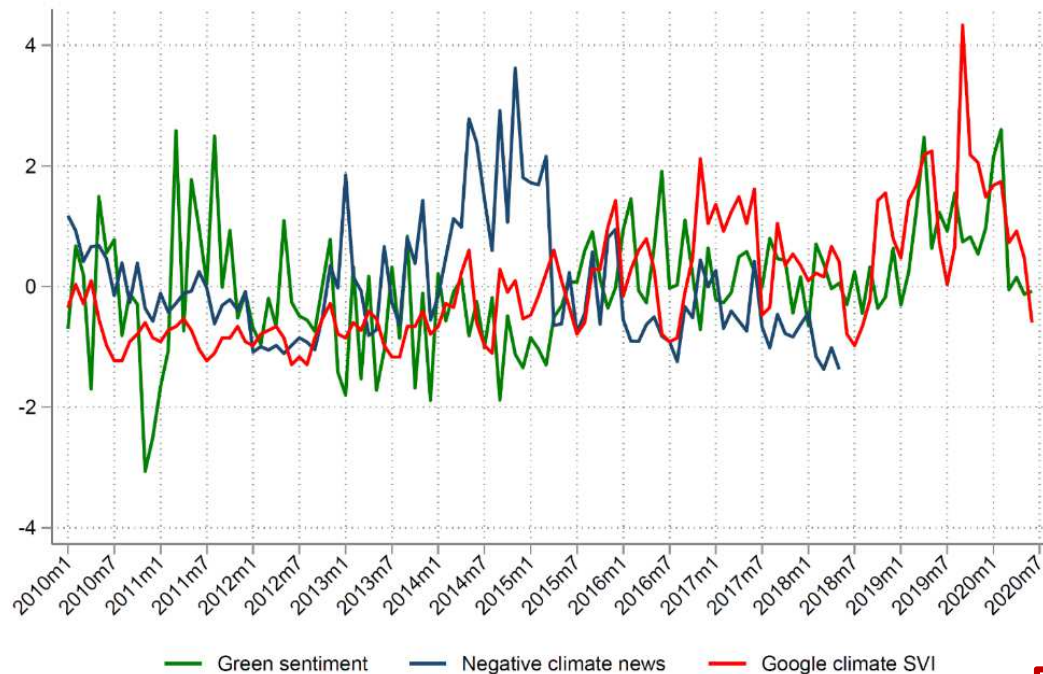
### Green ETFs

23 ETFs whose names include:  
“climate”, “carbon”, “clean”,  
“solar”, “fossil”, “renewable”,  
“environment”, “wind”,  
“ecological”, “green energy”,  
“progressive energy” (+ manual  
check).

Ticker	ETF name	Net expense ratio (bp)	Inception - delisting	Morningstar sustainable?
ICLN	iShares Global Clean Energy	48	2008 -	yes
TAN	Invesco Solar	70	2008 -	yes
SPYX	SPDR S&P 500 Fossil Fuel Reserves Free	20	2015 -	yes
CRBN	iShares MSCI ACWI Low Carbon Target	20	2014 -	yes
PBW	Invesco WilderHill Clean Energy	70	2005 -	yes
QCLN	First Trust NASDAQ Clean Edge Green Energy	60	2007 -	yes
PZD	Invesco Cleantech	68	2006 -	yes
ACES	ALPS Clean Energy	65	2018 -	yes
SMOG	VanEck Vectors Low Carbon Energy	63	2007 -	yes
EFAX	SPDR MSCI EAFE Fossil Fuel Free	20	2016 -	yes
FAN	First Trust Global Wind Energy	60	2008 -	yes
ETHO	Etho Climate Leadership US	47	2015 -	yes
PBD	Invesco Global Clean Energy	75	2007 -	yes
LOWC	SPDR MSCI ACWI Low Carbon Target	20	2014 -	yes
YLCO	Global X YieldCo&Renewable Engy Income	65	2015 -	no
EVX	VanEck Vectors Environmental Services	55	2006 -	yes
CNRG	SPDR Kensho Clean Power	45	2018 -	yes
VEGN	US Vegan Climate	60	2019 -	yes
CHGX	Change Finance US LargeCap FossilFuel Free	49	2017 -	yes
PUW	Invesco WilderHill Progressive Energy	70	2006 - 2019	yes
HECO	Strategy Shares EcoLogical Strategy	95	2012 -	yes
RENW	Pickens Morningstar Renewable Energy Response	65	2019 -	yes
ECLN	First Trust EIP Carbon Impact	95	2019 -	yes

# Identifying Green Sentiment

## The Green Sentiment Index



- **Negative climate news:** "Crimson Hexagon negative climate news" index proposed by Engle et al. (RFS, 2020).

- **Google climate SVI:** Google search value index in US for "Climate change" (Choi et al, RFS, 2020, Ilhan et al., RFS, 2021)

	1.	2.	3.
1. Green sentiment	1 (125)		
2. Negative climate news	-0.28*** (101)	1 (101)	
3. Google climate SVI	0.29*** (125)	0.08 (125)	1 (101)

Green sentiment correlates positively with Google climate SVI (0.29) but negatively with news-based climate risks (-0.28).

---

# 02

## Effect of green sentiment on stock returns



---

# Green sentiment and stock returns

## Estimating the effects of green sentiment

- OLS panel regression of monthly stock returns on green sentiment\*firm's environmental score, and firm characteristics (market beta, size, book-to-market, profitability, momentum, leverage), with industry FE, with/wo time FE, firm clustering

$$Ret_{i,t} = \alpha_t + \beta_t * Green\ sentiment_t * E\ score_{i,t} \\ + \theta_t * Green\ sentiment_t + \varphi_t * E\ score_t + \delta_t * Stock\ controls_{i,t} + \varepsilon_{i,t}$$

## Stocks and firm characteristics

- All common shares listed on US major stock exchanges (NYSE, NYSE Arca, AMEX, and NASDAQ) from **Compustat** Capital IQ North America Daily database
- Environmental ratings from **Sustainalytics** (robustness check with **MSCI-KLD**)
- Monthly data, sample period: January 2010 – June 2020

# Green sentiment and stock returns

## Descriptive statistics of firm characteristics

Explanatory variables

Dependent variables

	p5	p25	mean	p50	p75	p95	sd	N
Firm variables (monthly observations)								
Return	-13.07	-3.61	0.97	1.09	5.55	14.59	9.06	97,929
Cumulative return t+6	-29.10	-6.45	6.25	6.19	18.31	41.14	21.98	90,330
Env score	-1.30	-0.76	0.05	-0.12	0.73	1.95	1.02	97,929
Env score (kld)	0.00	0.00	0.17	0.00	0.33	0.67	0.25	92,452
Leverage	0.00	13.35	29.05	26.81	40.55	64.72	21.95	97,929
Market beta	0.21	0.72	1.13	1.08	1.48	2.23	0.63	97,929
Log(marketcap)	7.23	8.14	9.04	8.92	9.81	11.39	1.28	97,929
Book-to-market	0.03	0.21	0.46	0.38	0.63	1.15	0.44	97,929
Profitability	-3.78	1.48	4.78	4.28	8.12	16.01	7.75	97,929
Momentum	-2.90	-0.15	1.07	1.17	2.42	4.68	2.39	97,929
Firm variables (quarterly observations)								
Capex/PPE	-10.64	0.85	4.02	3.87	7.68	18.77	9.19	25,858
Cash/Assets	0.36	2.35	9.04	6.18	12.72	27.32	9.30	33,448

## Green sentiment and stock returns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	Return in t	Cumulative return through:					
		t+1	t+2	t+3	t+4	t+5	t+6
Green sentiment × Env score	0.084*** (3.09)	0.295*** (6.61)	0.305*** (5.96)	0.465*** (8.28)	0.539*** (8.70)	0.479*** (6.89)	0.589*** (7.53)
Green sentiment	-1.190*** (-42.16)	-2.182*** (-47.07)	-2.280*** (-42.68)	-2.360*** (-40.63)	-2.686*** (-42.08)	-2.212*** (-31.61)	-2.037*** (-26.20)
Leverage	0.002	0.004*	0.002	0.001	0.001	0.002	0.002
Market beta							
Log(marketcap)							
Book-to-market							
Profitability							
Momentum							
Constant							
Observations							
R-squared							
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

• Green firms with 1-SD ↑ Green Sentiment have a **8 bp** ↑ return in month t

• Shifts in green tastes are **persistent**: a ↑ green sentiment in t is followed by a **29 bp** ↑ return in t+1, effect growing until **59 bp** in t+6

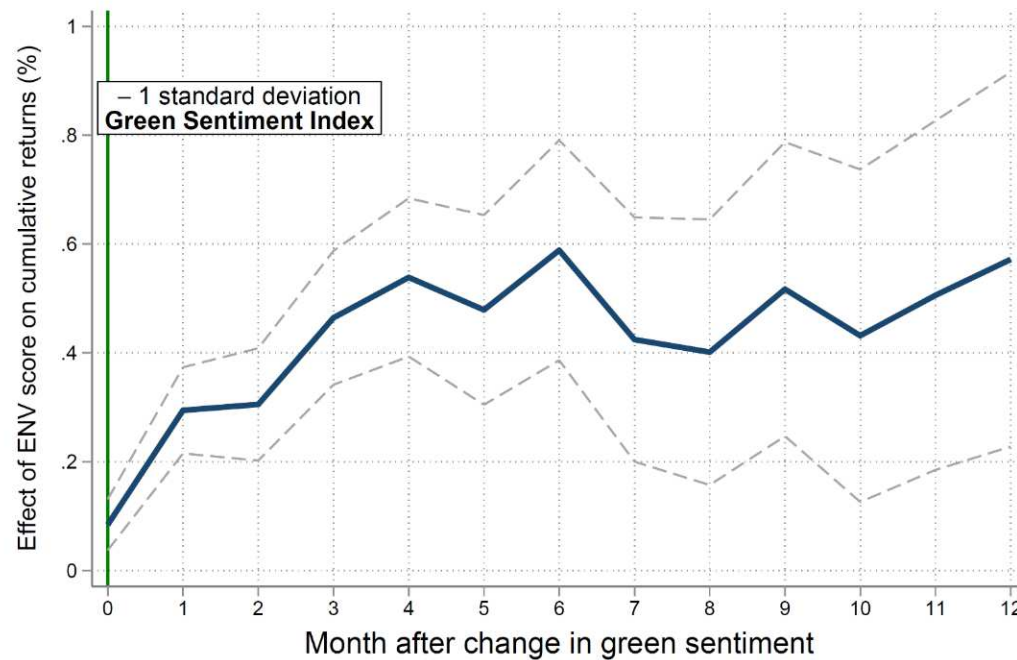
→ Green sentiment leads to a persistent outperformance of green stocks



---

## Green sentiment and stock returns

The effect does not revert even through  $t+12$



# Green sentiment and stock returns

## Green sentiment vs climate risk (1/2)

- How much is explained by sentiment vs fundamental news

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Return in t	Cumulative return through:					
		t+1	t+2	t+3	t+4	t+5	t+6
Green sentiment × Env score (kld)	0.075** (2.26)	0.450*** (9.01)	0.412*** (7.21)	0.639*** (9.43)	0.670*** (8.76)	0.590*** (6.85)	0.658*** (6.84)
Negative climate news × Env score (kld)	0.087* (1.85)	0.399*** (6.01)	0.529*** (6.50)	0.674*** (7.16)	0.633*** (5.86)	0.589*** (5.03)	0.613*** (4.67)
Env score	0.133*** (1.85)	0.374*** (6.01)	0.522*** (6.50)	0.688*** (7.16)	0.736*** (5.86)	0.778*** (5.03)	0.823*** (4.67)
Green sentiment	-1						
Negative climate news	-0						
Observations							
R-squared							
Firm controls							
Industry FE							

- Green sentiment and fundamental news have a similar impact on stock returns: **7.5 and 8.7 bp** in month t
- Both have a persistent effect (resp. **66 bp and 61 bp** in t+6)

→ Climate news and green sentiment impact stock prices through different channels



# Green sentiment and stock returns

## Green sentiment vs climate risk (2/2)

- Impact on analysts' forecast revisions

$\Delta$  EPS forecast:  
monthly change in average  
earnings forecasts (Landier  
and Thesmar, RCFS, 2020)

	(1)	(2)	(3)
Dependent variable:		$\Delta$ EPS forecast	
Horizon:	1-year ahead	2-year ahead	3-year ahead
Green sentiment $\times$ Env score	-0.002 (-0.05)	-0.023 (-1.14)	-0.016 (-0.54)
Negative climate news $\times$ Env score	0.003 (0.04)	0.098** (2.00)	0.006 (0.14)
Env score	-0.161** (-2.08)	-0.075 (-1.33)	-0.102** (-2.02)
Green sentiment	-0.087***	-0.165***	-0.185***
Negative climate news			
Observations			
R-squared			
Firm controls			
Industry FE			

→ **Green sentiment** does not explain EPS forecasts revisions, despite its effect on stock returns

→ **Negative climate news index** is associated with an increase in average EPS forecast of green firms at the 2-year horizon

# Green sentiment and stock returns

## Controlling for direct ETF price pressure

Do the results reflect a “mechanical” propagation of non-fundamental shocks from ETFs to the underlying securities, à la Franzoni et al. (2017)?

Dependent variable:	Return in t	Cumulative return through:					
		t+1	t+2	t+3	t+4	t+5	t+6
Green sentiment × Env score	0.068** (2.41)	0.271*** (5.33)	0.290*** (4.28)	0.441*** (5.59)	0.497*** (5.39)	0.400*** (3.65)	0.529*** (4.19)
Green sentiment × Green-ETF ownership	-0.285 (-0.60)	0.003 (0.01)	0.152 (0.16)	-0.682 (-0.56)	-0.767 (-0.44)	-0.900 (-0.42)	-0.898 (-0.33)
Green sentiment	-1.142*** (-36.21)	-2.145*** (-40.56)	-2.229*** (-33.85)	-2.249*** (-28.88)	-2.542*** (-27.98)	-2.079*** (-19.93)	-1.925*** (-16.75)
Env score	0.044 (1.30)	0.044 (0.63)	0.113 (1.12)	0.210 (1.58)	0.178 (1.09)	0.203 (1.04)	0.214 (0.94)
Green-ETF ownership	-2.016*** (-4.85)	-3.988*** (-4.45)	-6.183*** (-4.64)	-8.417*** (-5.04)	-10.029*** (-4.63)	-11.878*** (-4.54)	-14.620*** (-4.43)
Green sentiment	-1.142*** (-36.21)	-2.145*** (-40.56)	-2.229*** (-33.85)	-2.249*** (-28.88)	-2.542*** (-27.98)	-2.079*** (-19.93)	-1.925*** (-16.75)
Observations	95,248	93,972	92,704	91,444	90,199	88,969	87,756
R-squared	0.019	0.035	0.030	0.029	0.033	0.026	0.026
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Green-ETF ownership:  
% of market cap own by Green ETFs, based on CRSP mutual funds holdings data.

→ **Stocks held by green ETFs** are not affected more by higher green sentiment (due to ETF buying price pressure)

---

# 03

## Effect of corporate behavior



---

# Green sentiment and corporate behavior

## Estimating the effects of green sentiment

- OLS panel regression of quarterly firm's capital expenditures and cash holdings, for various levels of credit rating (low:<BBB-, middle, high:>=A)

$$\begin{aligned} \text{Capex (or Cash)}_{i,t} = & \alpha_t + \beta_t * \text{Green sentiment}_t * \text{E score}_{i,t} \\ & + \theta_t * \text{Green sentiment}_t + \varphi_t * \text{E score}_t + \delta_t * \text{Stock controls}_{i,t} + \varepsilon_{i,t} \end{aligned}$$

# Green sentiment and corporate behavior

## Financing channel mechanism

Green preferences can influence a firm's cost of capital, which in turn could allow green firms to make more investments (Heinkel et al., 2001; Pastor et al., 2020; Oehmke and Opp, 2020; Landier and Lovo, 2020; De Angelis et al., 2020)

Dependent variable:	Capex/PPE	Cash/Assets
Green sentiment (q) × Env score	0.257*** (3.50)	0.269*** (2.67)
Env score	-0.277*** (-15.20)	-0.099 (-1.01)
Leverage	-0.007 (-1.27)	-0.080*** (-5.51)
Market beta	-0.098 (-0.72)	0.205 (0.70)
Log(market cap)	0.064 (0.84)	-0.875*** (-4.71)
Book-to-market	-0.958*** (-3.98)	-3.870*** (-5.31)
Profitability		
Momentum		
Constant		
Observations	24,378	30,836
R-squared	0.035	0.276
Industry FE	Yes	Yes

1-SD ↑ average Green Sentiment over quarter  $q \rightarrow \uparrow$   
**0.26% capital investments** and **0.27% cash holdings**  
 in the same quarter (5% and 3% relative increase)

# Green sentiment and corporate behavior

## Heterogeneity across ratings

The effect is heterogenous based on firms' access to capital and equity dependence proxied by their rating (in line with Baker et al., 2003)

	Low credit rating	Medium credit rating	High credit rating
<b>Panel A: Dependent variable: Capex/PPE</b>			
Green sentiment (q) × Env score	0.477** (2.37)	0.235** (2.07)	-0.033 (-0.21)
<b>Panel B: Dependent variable: Cash/Assets</b>			
Green sentiment (q) × Env score	0.400** (1.98)	0.066 (0.57)	0.284* (1.86)

Green sentiment (q) × Env score
Env score
Green sentiment (q)
Observations
R-squared
Firm controls
Industry FE

- Green sentiment impact on Capex is concentrated on firms with **low/medium credit ratings**
  - Green sentiment impact on cash holdings is larger for firms with **low credit rating**
- Green sentiment has a larger impact on financially constrained firms, allowing them to invest hold more precautionary cash

---

## Concluding remarks

### Main contributions

- We proposed a novel measure of “green sentiment” based on the estimation of **non-fundamental demand shocks** on green ETFs
- Changes in green sentiment predict a **60 bp long-lasting stock price outperformance of more environmentally responsible firms** (economic impact comparable to that of climate news)
- A higher green sentiment allows **environmentally responsible firms to increase capital investments and cash holdings**

---

## Concluding remarks

### Policy implications

- A key difference between "green sentiment" and traditional "sentiment" is its **long-lasting impact** on assets' returns and its **real impact on firms**
- **Important role of capital markets:** shifts in investors' tastes can **tilt investment from brown to green firms**, which **affect the cost of capital**, which in turn affect **investment** (Battiston et al., 2021)
  - Risk that green sentiment may **divert resources away** from brown firms with high green innovation potential (Cohen et al., 2020)
  - How green firms **use the extra resources** is a critical issue



---

## — DISCLAIMER

The data used to carry out this study comes from the processing of record keeping and account keeping of AMUNDI ESR employee and pension savings accounts. These data have been analyzed anonymously for scientific, statistical or historical research purposes.

## — MENTIONS LÉGALES

### **Amundi Asset Management**

Société Anonyme au capital social de 1 086 262 605 euros

Société de Gestion de Portefeuille agréée par l'AMF sous le n° GP 04000036

Siège social : 90, boulevard Pasteur - 75015 Paris - France

Adresse postale : 90, boulevard Pasteur CS21564 - 75730 Paris Cedex 15 - France

Tél. +33 (0)1 76 33 30 30

Siren : 437 574 452 RCS Paris - Siret : 43757445200029 - Code APE : 6630 Z - N° Identification TVA : FR58437574452